Highly accurate calculation of photonic crystal band diagrams using pseudospectral methods

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We propose a novel analysis method for photonic crystal band diagrams using multidomain pseudospectral methods. By applying Chebyshev polynomials to the calculation of spatial derivatives at collocation points [1], the Helmholtz equation is converted into an eigenvalue problem. Astonishingly rapid numerical convergence of the band frequencies in two-dimensional problems are obtained compared with oscillatory convergence behavior versus the number of bases or grid points usually observed in the plane-wave expansion method and the finite-difference frequency-domain method. The nonuniform grid-size distribution in the Chebyshev collocation method provides great flexibility in efficient spatial-grid assignment. Numerical accuracy of the calculated normalized frequencies up to the 10^{-10} order has been achieved.

[1] C. Canuto, M. Y. Hussani, A. Quartweoni, and T. Zang, *Spectral Methods in Fluid Dynamics* (Springer-Verlag, 1988).